

**Environmental Air Monitoring Data Report
April Through June 2003
Moab Project Site
Moab, Utah**



Introduction

The U.S. Department of Energy Grand Junction Office (DOE-GJO) has established an air quality monitoring and surveillance network at the Moab Project site near Moab, Utah, that consists of on-site, off-site, and background monitoring locations. This monitoring network has been designed to collect data to determine (1) background air quality for the Moab area, (2) air quality at the millsite property (Moab Project site) boundary, and (3) potential effects to air quality at various off-site locations downwind of the uranium-ore mill tailings pile at the Moab Project site.

This Environmental Air Monitoring Data Report provides a summary of environmental data collected from DOE's air monitoring network during the second quarter of 2003 (April–June, 2003).

Environmental air monitoring data will be posted on the DOE-GJO website at www.gjo.doe.gov/Moab/Moab.html and will be updated as results are available (approximately every 3 months).

Why Collect Environmental Air Monitoring Data?

Atlas Minerals Corporation conducted uranium-ore milling operations at this location from approximately 1956 through 1984. During that time period, milling activities produced approximately 8.8 million cubic yards of uranium mill tailings that still remain on site in an unremediated impoundment. Most of the milling structures and buildings were dismantled and disposed of in the tailings pile in 1988.

Although the milling process removed most of the uranium from the ore, residual concentrations of uranium and other radioactive minerals (such as radium) remained in the waste mill tailings; these materials can pose risks to human health and the environment if they are not properly controlled. One of the ways of determining the effectiveness of existing controls is through air monitoring and surveillance.

What Types of Environmental Air Monitoring Data Are Being Collected at the Moab Project?

Following industry standards and practices for air monitoring, DOE's environmental air monitoring strategy at the Moab Project site is designed to monitor the specific airborne contaminants associated with uranium mill tailings: radon gas, gamma radiation, and certain airborne radioparticulates.

Radon

Radon is a naturally occurring, colorless, odorless, tasteless, radioactive gas that is formed from a series of decaying elements. At the beginning of the decay series is uranium, an element that breaks down to form radium. Radium, in turn, breaks down to form radon that further decays. In each case, the element breaking down releases a form of radiation known as alpha particles. Thus, uranium, radium, and radon are considered radioactive. Radon can be present in any type of soil and water and, because it is a gas, can also be present in the air. Typically, the concentration of radon in air is diluted and of little concern. However, radon concentrations are of significant interest to DOE because of the radium left in the tailings impoundment.

A prolonged exposure to high levels of radon has been linked to an increased risk of lung cancer. The amount of radon in the air is commonly measured in picocuries per liter (pCi/L). A "Curie" is a unit of measure used to describe the activity of radioactive materials. A "picoCurie" is equal to 1×10^{-12}

Curies (i.e., one-trillionth of a Curie). At the Moab Project site, radon is continuously monitored using “Track-Etch-type” alpha detectors that are exposed for 3-month intervals prior to analysis.

Gamma Radiation

We are exposed continuously to natural sources of radiation in our environment and on occasion to man-made sources of radiation. Natural sources of radiation include cosmic (e.g., radiation from the sun and outer space), terrestrial (i.e., radiation from naturally occurring minerals found in the Earth’s crust), internal emitters (i.e., natural radioactive materials present in the food and water we consume), and radon. Man-made sources of radiation include consumer products, medical applications, and industrial sources.

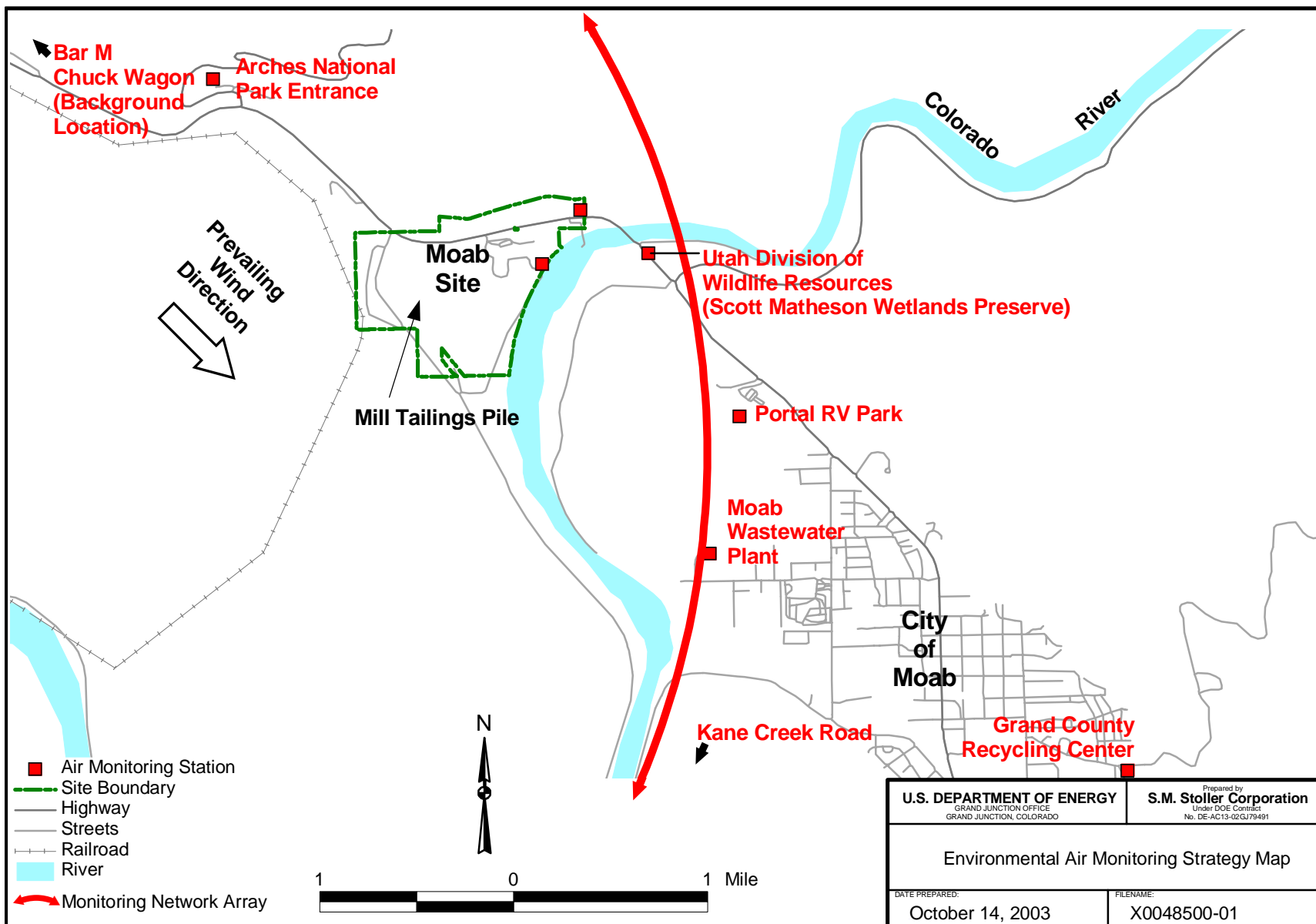
The uranium mill tailings at the Moab Project site are a source of gamma radiation. As uranium, radium, and thorium decay, several of the decay products emit gamma radiation. The electromagnetic energy associated with gamma rays (i.e., radiation) can travel several hundred feet in the air and can penetrate body tissues. Exposure to gamma radiation is known to affect human health negatively. Consequently, DOE has designed its environmental air monitoring network to monitor gamma radiation (i.e., dose rates) not only at its property boundary but also at various locations throughout the Moab community. Dose is expressed in terms of an exposure rate and is typically quantified in the units of millirems (roentgen equivalent man) per year (mrem/yr). Dose is continuously monitored at the Moab Project site with thermoluminescent dosimeters (TLDs) that are exposed for 3-month intervals prior to analysis.

Radioparticulates

Occasionally, high winds sweep dust and particulate matter from the Earth’s surface and redeposit these materials in other locations. The intent of the radioparticulate monitoring program at the Moab Project site is to monitor suspended air particulate matter for concentrations of radionuclides that may be transported off the Moab millsite. Particulate matter is monitored with a continuous air monitor that consists of a low-volume air sampling pump that draws air (at a prescribed flow rate) through a glass fiber filter. As air passes through the filter, any particulate matter suspended in the air is captured on the surface of the filter. The specific radionuclides that are commonly found in uranium mill tailings include radium-226 (Ra-226), thorium-230 (Th-230), polonium-210 (Po-210), and uranium (U-234, 235). Filters are collected at approximately 1-week intervals. Radioparticulates are measured in microcuries per milliliter ($\mu\text{Ci/mL}$) of air. A “micro-Curie” is equal to 1×10^{-6} Curies (i.e., one-millionth of a Curie).

DOE’s Environmental Air Monitoring Strategy

The objective of DOE’s environmental air monitoring program in Moab is to determine the contribution of airborne radiological contaminants from the Moab mill tailings site and the amount of radiological contamination at the millsite boundary and at off-site locations throughout the community. To accomplish this objective, DOE established a network of monitoring locations with instruments that measure various parameters along the millsite boundary and at off-site locations. The majority of the off-site locations are located immediately downwind of the mill tailings pile and in a linear array immediately upwind of the general population center of the City of Moab. This strategy provides a “first line of defense” in identifying concentrations of any off-site airborne contamination and provides specific information relative to the dose that the public may be receiving from the mill tailings site ([Figure 1](#)). A summary of the types of data collected at the on-site, off-site, and background monitoring locations is provided in [Table 1](#).



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Figure 1. Environmental Air Monitoring Strategy Map

Table 1. Summary of On-Site and Off-Site Air Monitoring Locations at Moab Project Site

Monitoring Station	Location	Parameter: Radioparticulate (RP), Atmospheric Radon (Rn), and Environmental Gamma (G)
On-Site Locations		
MPS-0101	Millsite, Perimeter	Rn, G
MPS-0102	Millsite, Perimeter	Rn, G, RP
MPS-0103	Millsite, Perimeter	Rn, G
MPS-0104	Millsite, Perimeter	Rn, G
MPS-0105	Millsite, Perimeter	Rn, G, RP
MPS-0106	Millsite, Perimeter	Rn, G
MPS-0107	Millsite, Perimeter	Rn, G, (duplicate G)
MPS-0108	Millsite, Perimeter	Rn, G
MPS-0109	Millsite, Perimeter	Rn, G
MPS-0110	Millsite, Perimeter	Rn, G
MPS-0111	Millsite, Perimeter	Rn, G
MPS-0112	Millsite, Perimeter	Rn, G
MPS-0113	Millsite, Perimeter	Rn, G
MPS-0114	Millsite, Tailings Pile	Rn, G
MPS-0115	Millsite, Tailings Pile	Rn, G
MPS-0116	Millsite, Tailings Pile	Rn, G
Off-Site Locations	Bar M Chuck Wagon (background location 6 miles north of Moab Project site)	Rn, G, RP, (duplicate G)
MPS-0117		
MPS-0118	Arches National Park Entrance	Rn, G, RP
MPS-0119	Utah Division of Wildlife Resources, Scott Matheson Wetlands Preserve	Rn, G, RP
MPS-0120	Portal RV Park	Rn, G, RP
MPS-0121	City of Moab, Wastewater Treatment Plant	Rn, G, RP
MPS-0122	Grand County Recycling Center	Rn, G, RP
MPS-0123	Kane Creek Road (background location 2.5 miles southwest of millsite)	Rn, G, RP
MPS-0124	Utah Division of Wildlife Resources, Scott Matheson Wetlands Preserve	Rn, G
MPS-0125	Utah Division of Wildlife Resources, Scott Matheson Wetlands Preserve	Rn, G
MPS-0126	Private Property (vacant land) approximately 1/4 mile south of Millsite	Rn, G
MPS-0127	Private Property (vacant land) approximately 1/2 mile south of Millsite	Rn, G, (duplicate G)
MEI	Maximally Exposed Individual: Caretaker Housing at Tex's River Tours	Rn, (duplicate Rn)

Summary:

Total on-site monitoring stations: 16
 Total off-site monitoring stations: 12
 Total radon monitoring stations: 28
 Total gamma monitoring stations: 28
 Total radioparticulate monitoring stations: 9 (two on site and seven off site)

A meteorological monitoring station is also located on site. Wind speed and direction, temperature, and precipitation are monitored at this station.

Data Summary

A summary of DOE's environmental air monitoring data collected during the period of April – June, 2003 at the Moab Project site and at off-site locations is presented in [Tables 2](#) and [3](#).

Graphical presentation of summaries of environmental air monitoring data collected to date are also presented in [Figures 2](#) through [7](#). These figures display both on- and off-site data for each of the parameters being monitored.

Conclusions

DOE Order 5400.5, *Radiation Protection of the Public and the Environment*, establishes both guidelines and standards for operations of DOE and DOE contractors with respect to protection of the public and environment against undue risk from radiation.

Chapter II of the DOE order sets public dose limits for members of the public at 100 mrem/yr from DOE radiation sources. The DOE Order excludes contributions from radon in the dose limit. Chapter III (Figure III-3) provides a concentration in air limit of 3.0 pCi/L at the site boundary. Chapter IV applies to residual radioactive material but does not apply to uranium mill tailings. DOE Order 5400.5 is applicable to the Moab Project site for determining an atmospheric radon guideline.

In the absence of a federal environmental radon standard that is directly applicable to the Moab Project site and its current condition, the DOE goal for atmospheric radon emissions at the site boundary and any off-site locations is that such emissions should not exceed 3.0 pCi/L plus background (annual average radon concentration). This radon goal is not an enforceable environmental standard, but it is a self-imposed guideline, the applicability of which will be periodically evaluated as additional monitoring data are collected.

Questions?

Any questions or comments regarding the information provided in this data report may be directed to:

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Table 2. Summary of Radioparticulate Air Monitoring Data for the Moab Project Site for Calendar Year 2003

Station Number	Isotope	First Quarter 2003 ($\mu\text{Ci/mL}$)	Second Quarter 2003 ($\mu\text{Ci/mL}$)	Third Quarter 2003 ($\mu\text{Ci/mL}$)	Fourth Quarter 2003 ($\mu\text{Ci/mL}$)	Annual Average ($\mu\text{Ci/mL}$)
On-Site Locations						
MPS-0102 (East Property Line)	Uranium-Total	1.5E-16	2.0E-16			
	Thorium-230	2.1E-16	2.5E-16			
	Radium-226	3.2E-16	2.9E-16			
	Polonium-210	4.2E-15	2.5E-15			
MPS-0105 (River Berm)	Uranium-Total	3.2E-16	8.5E-16			
	Thorium-230	3.3E-16	6.5E-16			
	Radium-226	3.5E-16	4.2E-16			
	Polonium-210	6.1E-15	3.8E-15			
Off-Site Locations						
MPS-0117 (Bar M Chuck Wagon)	Uranium-Total	1.1E-16	1.3E-16			
	Thorium-230	2.2E-16	2.0E-16			
	Radium-226	3.1E-16	2.0E-16			
	Polonium-210	4.0E-15	3.2E-15			
MPS-0118 (Arches National Park Entrance)	Uranium-Total	1.0E-16	1.6E-16			
	Thorium-230	2.5E-16	2.2E-16			
	Radium-226	3.1E-16	2.0E-16			
	Polonium-210	4.4E-15	3.2E-15			
MPS-0119 (Scott Matheson Wetlands Preserve)	Uranium-Total	1.1E-16	1.5E-16			
	Thorium-230	2.4E-16	2.4E-16			
	Radium-226	3.2E-16	1.9E-16			
	Polonium-210	4.8E-15	3.2E-15			
MPS-0120 (Portal RV Park)	Uranium-Total	1.5E-16	2.0E-16			
	Thorium-230	3.4E-16	4.2E-16			
	Radium-226	3.1E-16	4.2E-16			
	Polonium-210	4.3E-15	2.8E-15			
MPS-0121 (Moab Wastewater Treatment Plant)	Uranium-Total	1.3E-16	1.3E-16			
	Thorium-230	2.3E-16	1.7E-16			
	Radium-226	3.4E-16	1.8E-16			
	Polonium-210	4.5E-15	3.2E-15			
MPS-0122 (Grand County Recycling Center)	Uranium-Total	1.2E-16	1.3E-16			
	Thorium-230	3.2E-16	2.8E-16			
	Radium-226	3.4E-16	2.0E-16			
	Polonium-210	4.2E-15	3.4E-15			
MPS-0123 (Kane Creek Road)	Uranium-Total	9.5E-17	1.3E-16			
	Thorium-230	2.1E-16	2.6E-16			
	Radium-226	3.3E-16	1.8E-16			
	Polonium-210	4.3E-15	2.6E-15			

Table 3. Summary of Environmental Radon and Gamma Monitoring Data for the Moab Project Site for Calendar Year 2003

Station Number	First Quarter 2003 (01/07/03 – 03/31/03)		Second Quarter 2003 (3/31/03 – 07/09/03)		Third Quarter 2003		Fourth Quarter 2003	
	Radon (pCi/L)	Gamma (mrem/91 d) (EAA) ⁵	Radon (pCi/L)	Gamma (mrem/91 d) (EAA)	Radon (pCi/L)	Gamma (mrem/91 d) (EAA)	Radon (pCi/L)	Gamma (mrem/91 d) (EAA)
On-Site Locations								
MPS- 0101¹	3.2	77.3 (310)	1.8	62.9(252)	NDA	NDA	NDA	NDA
MPS-0102¹	2.3	26.4(106)	2.1	21.4(86)	NDA	NDA	NDA	NDA
MPS-0103¹	1.6	27.6(111)	1.2	21.5(86)	NDA	NDA	NDA	NDA
MPS-0104¹	2.9	34.4(138)	2.3	25.2(101)	NDA	NDA	NDA	NDA
MPS-0105¹	3.4	50.8(204)	2.8	43.0(173)	NDA	NDA	NDA	NDA
MPS-0106¹	8.3	43.0(172)	7.1	34.5(138)	NDA	NDA	NDA	NDA
MPS-0107¹	6.8	55.0(221)	6.4	50.7(203)	NDA	NDA	NDA	NDA
MPS-0108¹	4.8	126.9(509)	6.2	120.6(484)	NDA	NDA	NDA	NDA
MPS-0109¹	1.6	56.7(227)	2.1	52.9(212)	NDA	NDA	NDA	NDA
MPS-0110¹	1.3	84.5(340)	2.9	77.7(312)	NDA	NDA	NDA	NDA
MPS-0111¹	1.0	65.8(264)	1.9	55.0(221)	NDA	NDA	NDA	NDA
MPS-0112¹	1.4	44.7(179)	2.5	34.7(139)	NDA	NDA	NDA	NDA
MPS-0113¹	2.7	99.0(397)	2.5	84.7(340)	NDA	NDA	NDA	NDA
MPS-0114¹	4.2	418.1(1,677)	5.3	354(1,420)	NDA	NDA	NDA	NDA
MPS-0115¹	5.2	247.5(993)	6.1	195.8(785)	NDA	NDA	NDA	NDA
MPS-0116¹	4.8	145.2(583)	5.8	121.6(488)	NDA	NDA	NDA	NDA
Off-Site Locations								
MPS-0117^{2,3}	0.5	21.6(87)	0.8	19.9(80.0)	NDA	NDA	NDA	NDA
MPS-0118²	0.7	23.4(94)	0.7	23.0(92)	NDA	NDA	NDA	NDA
MPS-0119²	1.0	19.8(79)	1.0	21.0(84)	NDA	NDA	NDA	NDA
MPS-0120²	0.6	16.1(65)	1.0	15.2(61)	NDA	NDA	NDA	NDA
MPS-0121²	0.4	21.0(84)	0.7	18.2(73)	NDA	NDA	NDA	NDA
MPS-0122^{2,3}	0.6	18.6(75)	0.5	15.2(61)	NDA	NDA	NDA	NDA
MPS-0123^{2,3}	0.4	19.0(77)	0.4	14.8(59)	NDA	NDA	NDA	NDA
MPS-0124^{2,3}	1.9	74.9(300)	0.9	79.1(317)	NDA	NDA	NDA	NDA
MPS-0125^{2,3}	2.0	80.9(325)	1.9	75.3(302)	NDA	NDA	NDA	NDA
MPS-0126^{2,3}	1.7	79.1(318)	2.3	76.3(306)	NDA	NDA	NDA	NDA
MPS-0127^{2,3}	1.4	74.3(298)	1.0	83.2(334)	NDA	NDA	NDA	NDA
MEI⁴	1.9 (1.7)dup	NA	1.2(1.8)	NA	NDA	NDA	NDA	NDA

¹ On-site monitoring location. Located within DOE property boundary.

² Off-site monitoring location.

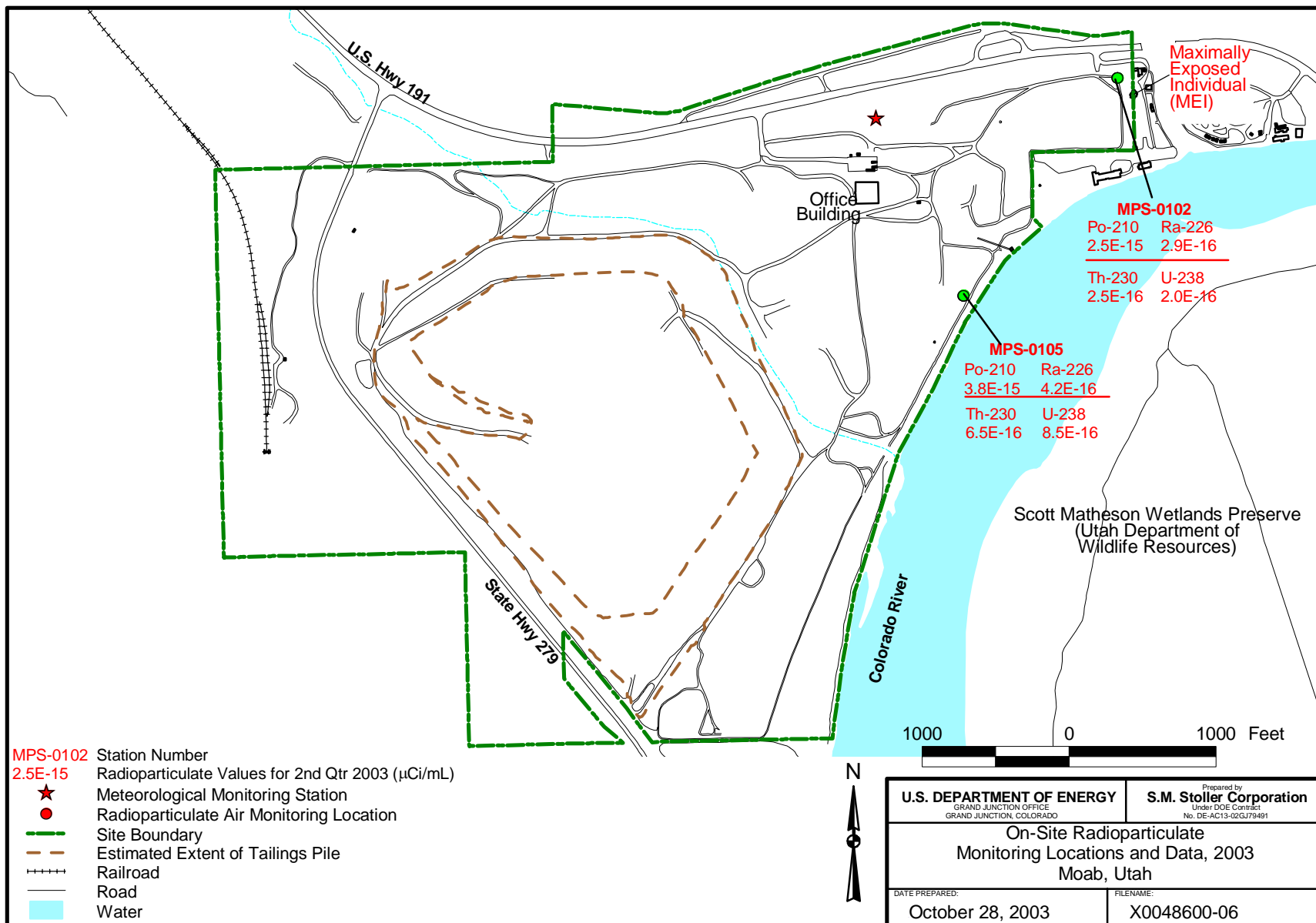
³ Designated background monitoring location. Background locations are located at sufficient distances away from the millsite to be free from any affects or influences from potential site contaminants.

⁴ The maximally exposed individual (MEI) is the continually occupied residential property that is closest to the DOE property boundary.

⁵ "EAA" is the estimated annual average and is calculated by dividing the actual reading by the number of days of the exposure period, then multiplying by 365. Values for annual averages are in units of mrem/yr.

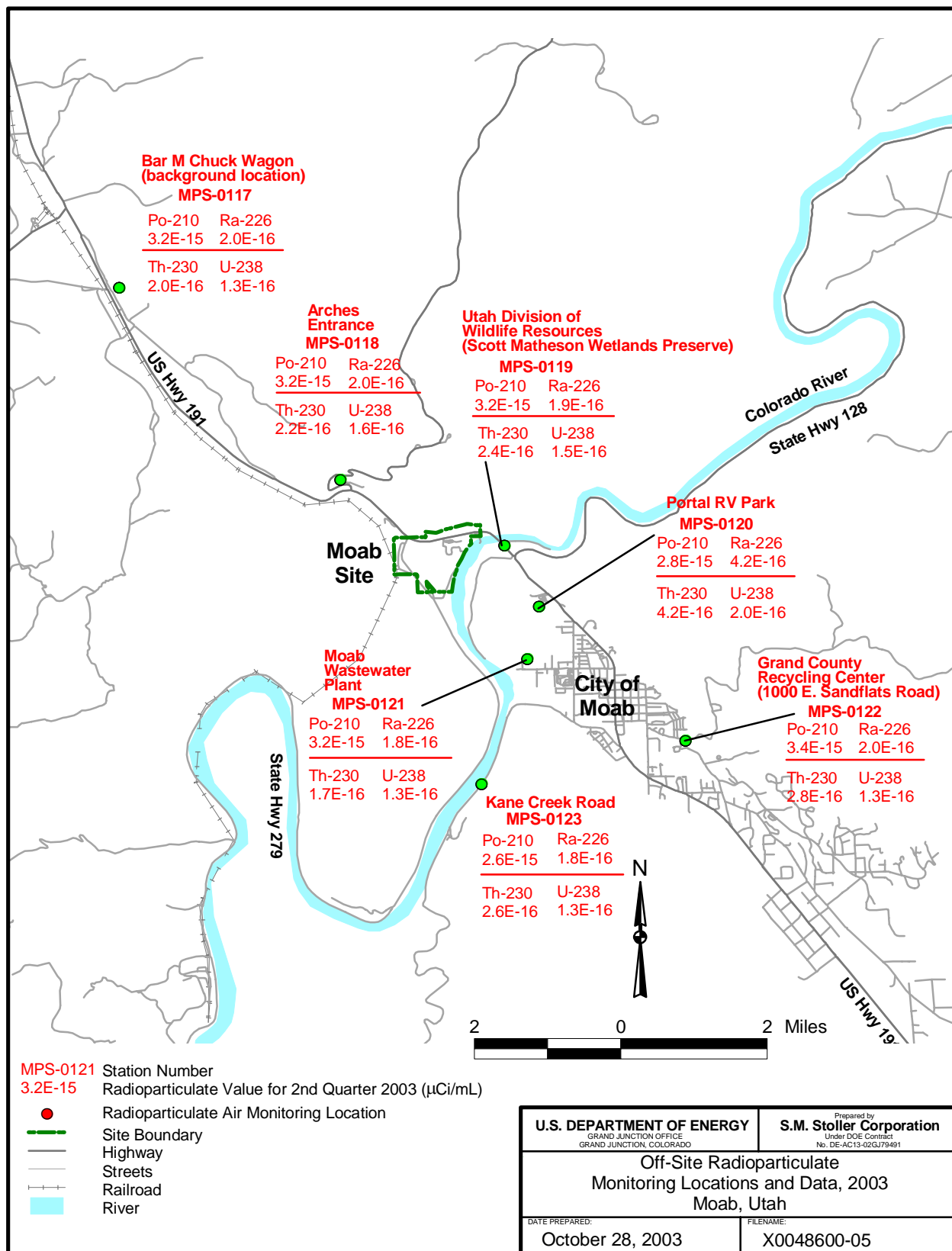
NA = Not Applicable.

NDA = No Data Available.



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Figure 2. On-Site Radioparticulate Monitoring Locations and Data, April through June 2003 (Values from Table 2)



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Figure 3. Off-Site Radioparticulate Monitoring Locations and Data, April through June 2003 (Values from Table 2)

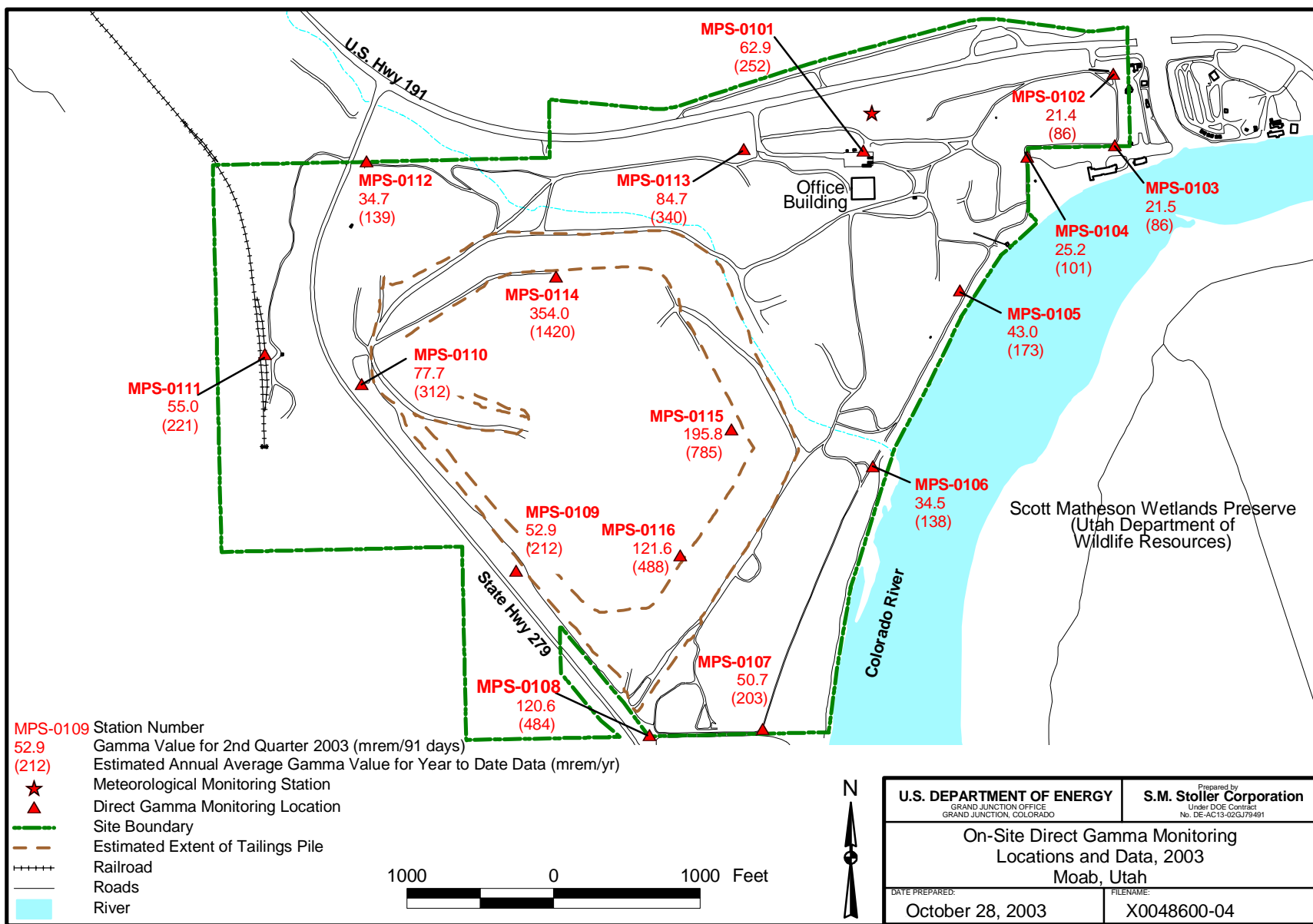


Figure 4. On-Site Gamma Monitoring Locations and Data, April through June 2003 (Values from Table 3)

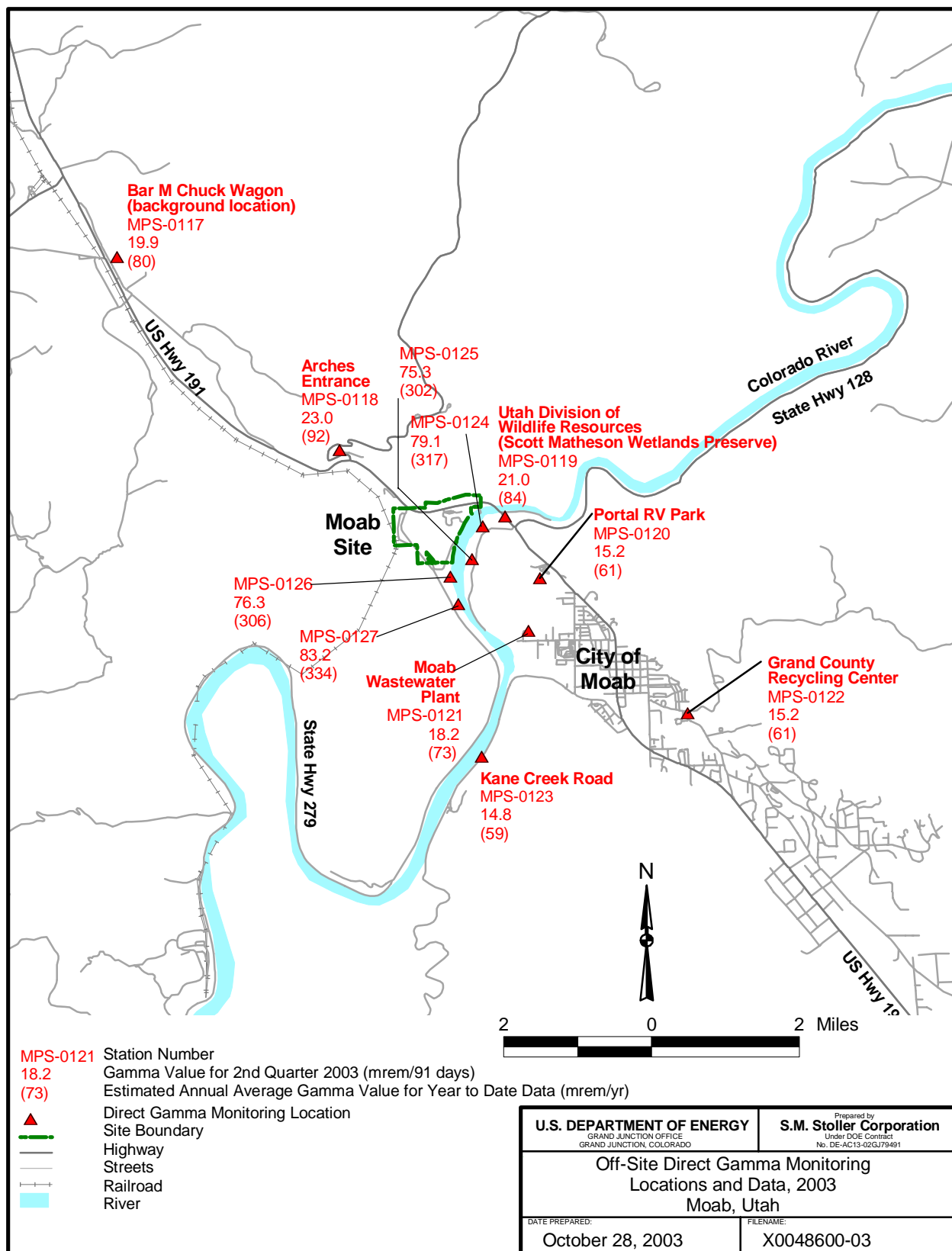


Figure 5. Off-Site Gamma Monitoring Locations and Data, April through June 2003 (Values from Table 3)

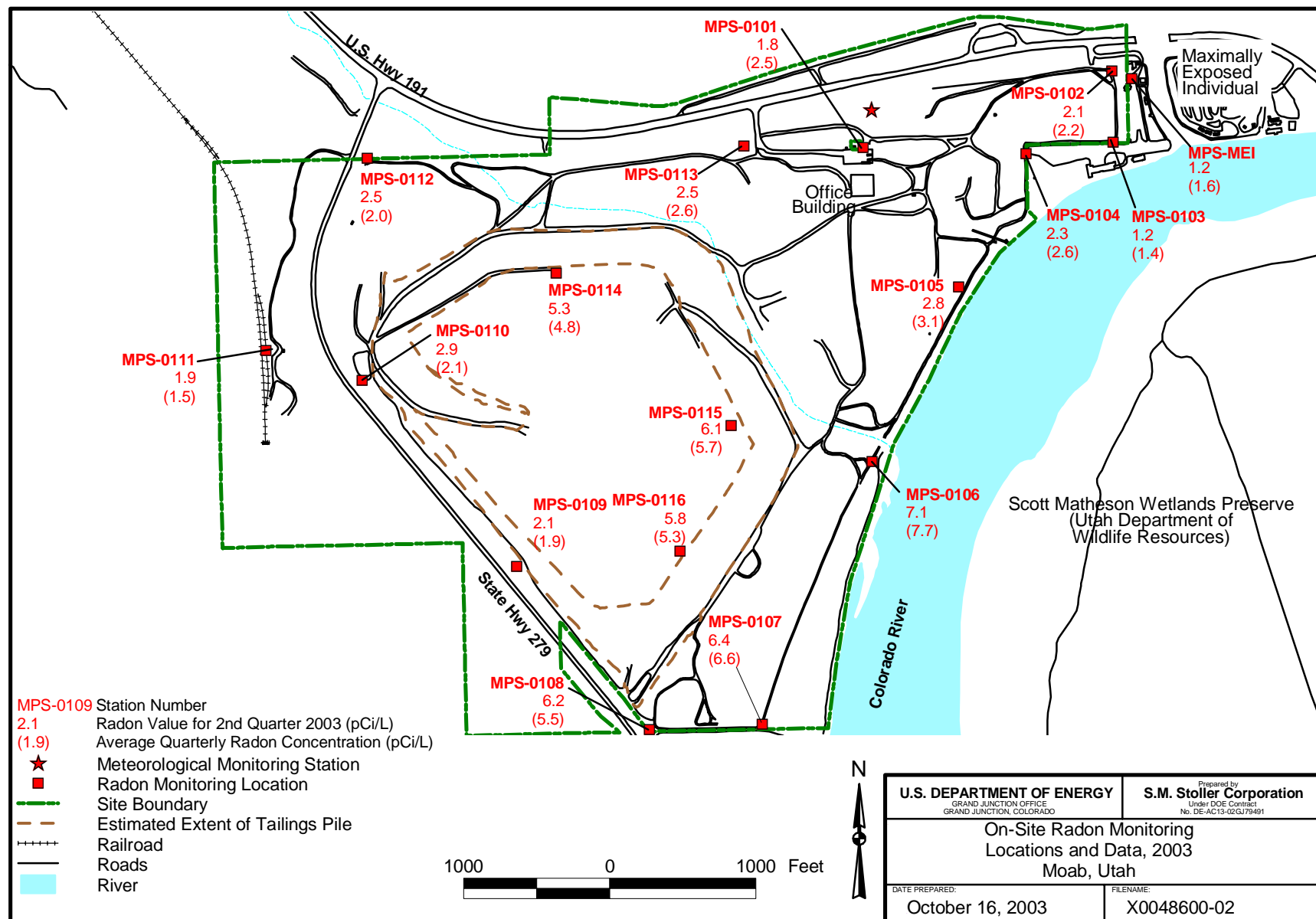


Figure 6. On-Site Radon Monitoring Locations and Data, April through June 2003 (Values from Table 3)

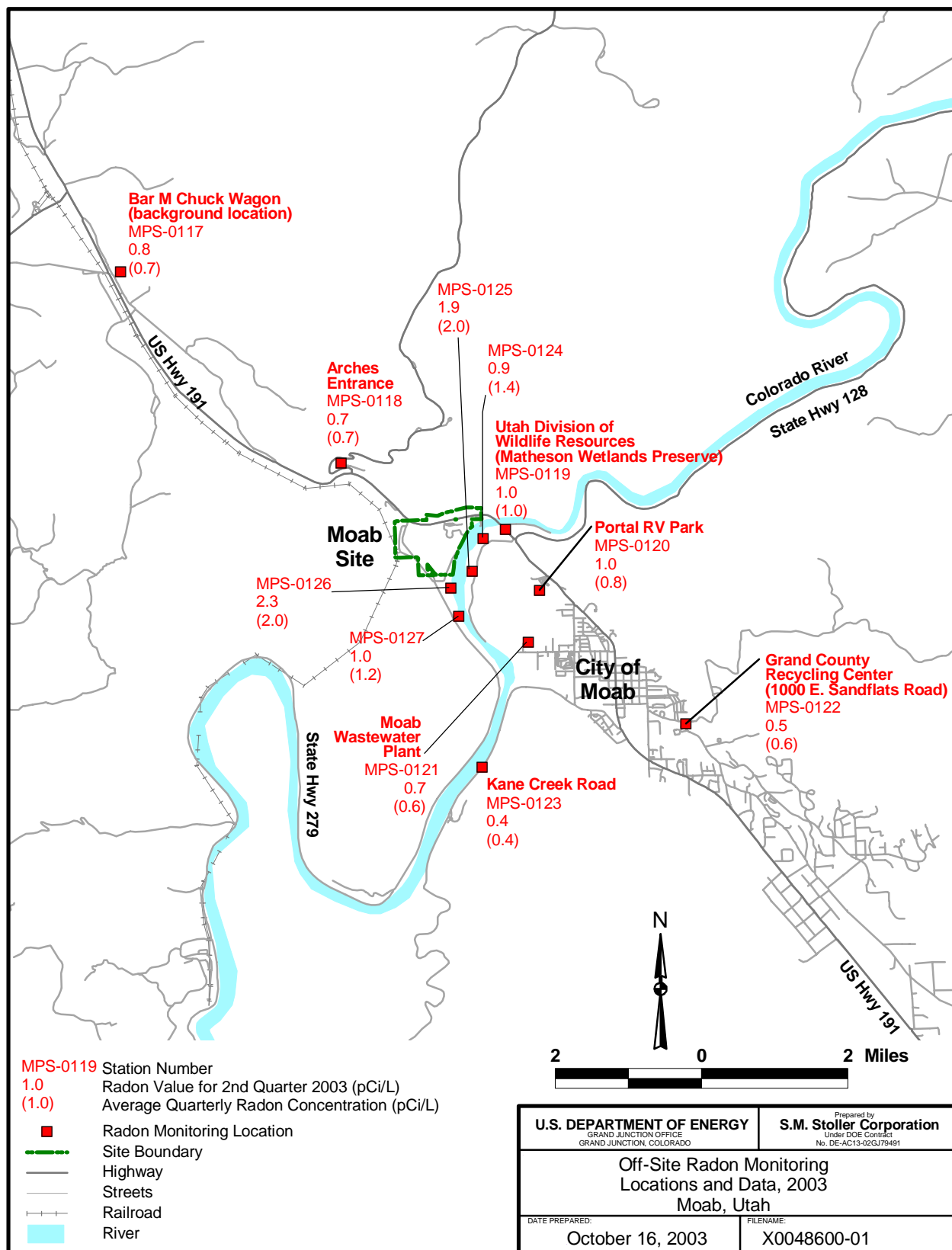


Figure 7. Off-Site Radon Monitoring Locations and Data, April through June 2003 (Values from Table 3)

Links to Other Websites

The following websites provide additional information regarding radon exposures and radiation hazards associated with uranium mill tailings:

<http://www.epa.gov/radiation/index.html>

<http://www.epa.gov/iaq/radon/riskcht.html>

<http://www.epa.gov/iaq/radon/pubs/physic.html>

<http://www.ehs.ucf.edu/radon.html>

References

40 *Code of Federal Regulations* (CFR), Part 61, “National Emission Standards for Hazardous Air Pollutants.”

40 CFR 192, “Health and Environmental Protection Standards for Uranium and Thorium Mill Tailings.”

U.S. Environmental Protection Agency (EPA), 1989. *Quality Assurance Handbook for Air Pollution Measurement Systems, Volume II*.

U.S. Department of Energy (DOE), DOE Order 5700.6C, *Quality Assurance*.

———, DOE Order 231.1, *Environment, Safety, and Health Reporting*.

———, DOE Order 5400.1, *General Environmental Protection Program*.

———, DOE Order 5400.5, *Radiation Protection of the Public and the Environment*.

———, *Environmental Regulatory Guide for Radiological Effluent Monitoring and Environmental Surveillance*, DOE/EH-0173T, January 1991.

Utah Administrative Code (U.A.C.), R307–205–6: *Emission Standards: Fugitive Emissions and Fugitive Dust*, September 2001, Salt Lake City, Utah.

———, R313–15–301: *Standards for Protection Against Radiation, Dose Limits for Individual Members of the Public*, September 2001, Salt Lake City, Utah.